INSTRUCTION MANUAL — PART TWO

for

MODEL LTU-1 RF TUNING UNIT

(10 Mc–1000 Mc)

PART OF MODEL LSA

ALL BAND, DIRECT READING

SPECTRUM ANALYZER

POLARAD ELECTRONICS CORP.

100 METROPOLITAN AVE.
BROOKLYN 11, N. Y.
STagg 2-3464

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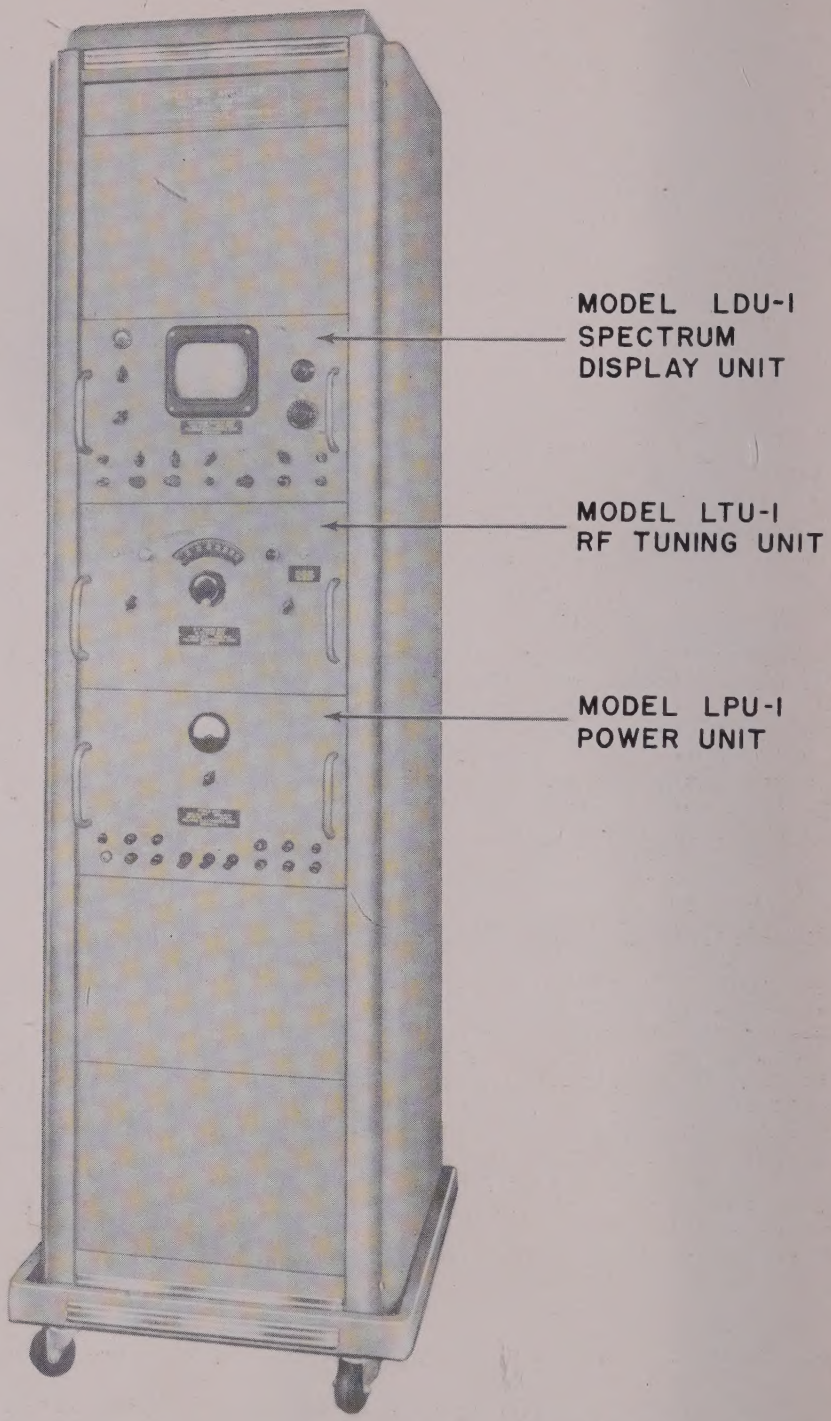

FIGURE 1. MODEL LSA SPECTRUM ANALYZER, FRONT VIEW.

PART II

MODEL LTU-1

RF TUNING UNIT

(10 Mc - 1000 Mc)

SECTION I

GENERAL DESCRIPTION

1. ORGANIZATION OF MANUAL.

a. This instruction manual describes the Model LTU-1 RF Tuning Unit, which is a part of the Model LSA All-band Direct reading Spectrum Analyzer, designed and manufactured by the Polarad Electronics Corporation of Brooklyn, N. Y. (See figure 1.) The manual describes the electrical and mechanical features of the RF Tuning Unit covering the frequency range from 10 mc - 1000 mc.

b. Part I of the manual contains descriptive and maintenance data for the basic units of the Spectrum Analyzer, which consist of the Model LDU-1 Display Unit, the Model LPU-1 Power Unit, and the Model LKU-1 Klystron Power Unit. Part III of the manual provides complete operational and adjustment data for the Model LTU-2 RF Tuning Unit, covering the frequency range from 940 mc to 4500 mc. Part IV is an operating and service manual for the Model LTU-3 RF Tuning Unit, covering the frequency range from 4460 mc to 16,520 mc, while this manual, Part II, is applicable to the Model LTU-1 RF Tuning Unit only.

2. PURPOSE OF THE SPECTRUM ANALYZER.

a. Polarad's Model LSA Spectrum Analyzer is a laboratory instrument which is used to provide a visual indication of the frequency distribution of energy in an rf signal in the range covered by the tuning unit in use. With the Model LTU-1 Tuning Unit connected to the basic units, radio signals in the frequency range from 10 mc to 1000 mc are converted to an intermediate frequency of 160 mc, at a power level sufficient to drive the various circuits located within the Model LDU-1 Display Unit. Signals received and detected by this tuning unit are presented visually as a plot of voltage, on the vertical axis, versus frequency, on the horizontal axis, of the oscilloscope within the Display Unit. Controls are provided on the Display Unit front panel for observing on the cathode-ray tube screen a band of frequencies as narrow as 250 kc, adjustable continuously to a band as wide as 5 mc when the 10 to 100 mc range of the tuning unit is used, or as wide as 25 mc when the 100 to 1000 mc range is used.

b. Specific applications of the Spectrum Analyzer consist of:

(1) Observing and measuring the sidebands associated with amplitude and/or frequency-modulated signals;

(2) Determining the presence and accurately measuring the frequency of radio and/or radar signals;

(3) Checking the spectrum of magnetron oscillators;

(4) Measuring noise spectra;

(5) Checking and observing the tracking of rf components of a radar system;

(6) Comparing two rf signals differing by a small frequency separation.

3. EQUIPMENT SUPPLIED.

a. Figure 1 shows the basic units of the Spectrum Analyzer, and one of the RF Tuning Units mounted within the deluxe steel test-rack type cabinet. The Model LTU-1 RF Tuning Unit is supplied complete on a rack panel 12½" high by 19" wide on a chassis 21-3/4" deep, as measured from front of handles to the rear of the chassis. (See figure 2.)

b. One filter cable, for use in the Model LDU-1 Display Unit, is supplied, and functions to eliminate a spurious response occurring at 16 mc.

4. ELECTRICAL CHARACTERISTICS, MODEL LTU-1 RF TUNING UNIT.

a. FREQUENCY CALIBRATION. -- The Model LTU-1 RF Tuning Unit operates over the frequency range from 10 mc to 1000 mc. This range is covered in three bands, which may be chosen by the RANGE SELECTOR, located on the front panel. The low band covers the frequency spectrum from 9.5 mc to 100 mc. The middle band covers the range from 80 mc to 550 mc, while the high band is used in operating over the frequency range from 320 mc to 1260 mc. The RANGE SELECTOR switch has two positions, and selects either the 10-100 mc band, or the two upper bands.

b. OPERATING POWER REQUIREMENTS. -- Operating power for this tuning unit is supplied by the Model LPU-1 Power Unit, which supplies the 115-volt ac power for the transformer, located on the Tuning Unit chassis. This transformer supplies the 6.3 volt ac power for the heaters of all tubes and pilot lamps used in the equipment. In addition, the Model LPU-1 Power Unit supplies a positive 150 volt potential for the local oscillators. A positive 105 volt potential is supplied from the Power Unit for the preamplifier tubes. The Klystron Power Unit is NOT required when the Spectrum Analyzer is operated with the Model LTU-1 RF Tuning Unit.

5. PHYSICAL FEATURES.

a. The Model LTU-1 RF Tuning Unit contains two local oscillators, one for the 10 to 100 mc band of operation, and one for the 100 to 1000 mc range of operation, a ten stage preamplifier, a 1N21 crystal mixer which is operative only over the upper frequency bands, an IF ATTENUATOR control, a RANGE SELECTOR and a filament transformer which is protected against overload and short-circuiting by 1-ampere fuses in each input line. The unit is tuned manually by rotating the TUNING knob, which is ganged by a gear and pulley system to the tuning dial and to the frequency determining tank circuits within each of the oscillator compartments. Tuning dial indications are accurate to better than 1%. The chassis is secured by bolts and nuts to a front panel which is painted in a gray satin finish. Two handles, located at the two sides of the front panel, are provided for ease in handling the Tuning Unit on its draw slides in the deluxe test rack supplied. At the rear of the unit are the two operating fuses, two spare fuses, the POWER receptacle J1001 for connection to the Model LPU-1 Power Unit, and the DISPLAY UNIT jack J1002 for connection via coaxial cable to the Model LDU-1 Spectrum Display Unit.

6. TECHNICAL SUMMARY, MODEL LTU-1 RF TUNING UNIT.

Frequency range:
Low.....9.5 mc to 100 mc.

Middle.....80 mc to 550 mc.
High.....320 mc to 1260 mc.

Bandwidth:
Low range.....5 mc.
High ranges.....25 mc.

Sensitivity:
Low range.....-97 dbw.
High range.....-90 dbw.

Tube complement.....9-6AK5; 1-6AS6; 1-6J6; 1-5675.

Power Input:
DC.....+105 v; +150 v.
AC.....115 v, 50/60 cps.

Frequency accuracy.....Better than 1%.

IF Attenuator.....60 db, in 6 db steps.

Input impedance.....50 ohms coaxial.

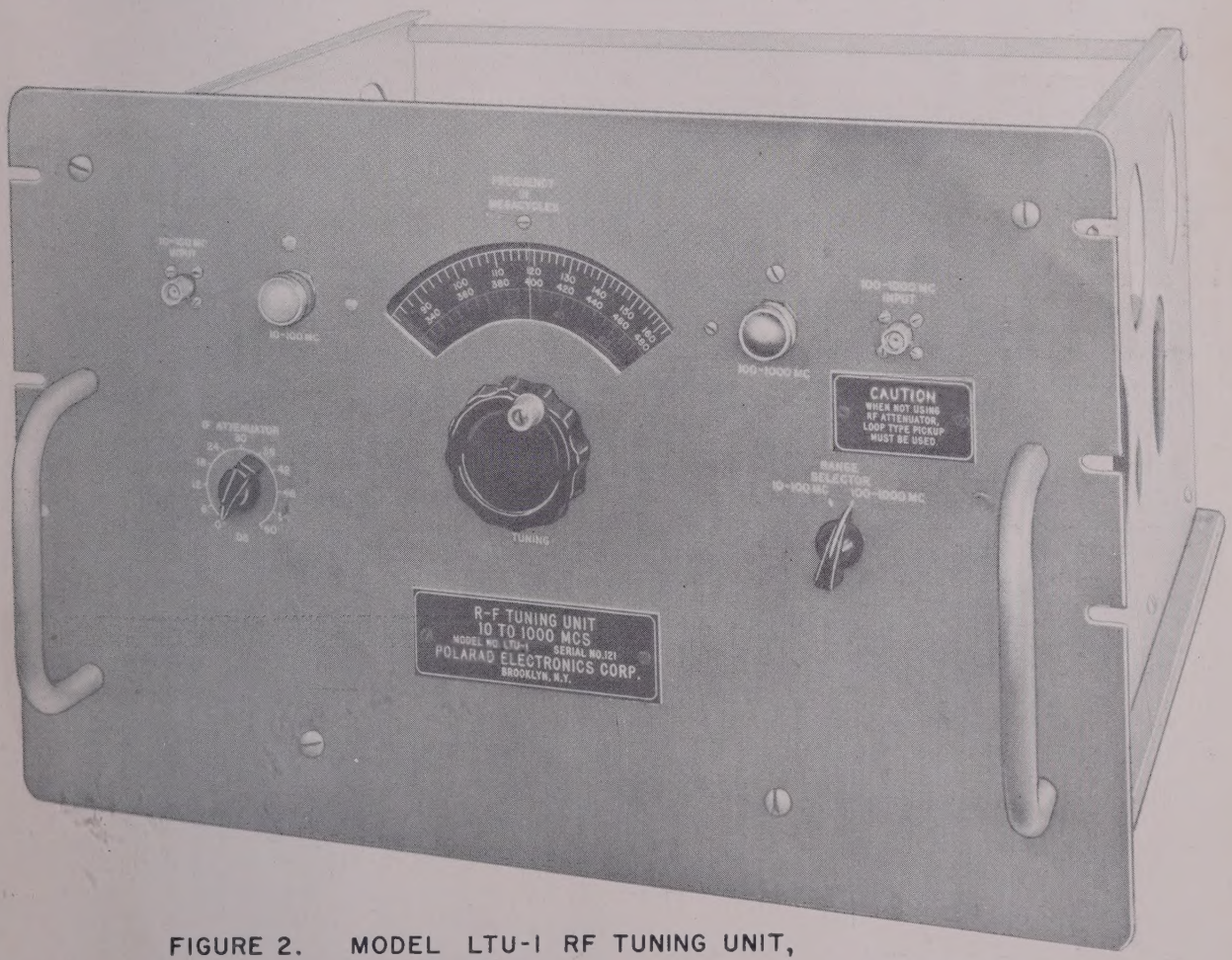

FIGURE 2. MODEL LTU-1 RF TUNING UNIT, FRONT VIEW.

SECTION II

OPERATING INSTRUCTIONS

1. INTER-UNIT CABLING CONNECTIONS. (Refer to fig. 3).

a. Connect the Model LTU-1 RF Tuning Unit to two of the basic units of the Spectrum Analyzer as directed below:

(1) Connect the Input Power Cable W1 from the POWER IN receptacle J1, on the rear of the Model LPU-1 Power Unit, to a 115-volt 50/60 cps power source, capable of delivering 600 watts.

(2) Connect power cable W2 from the Power Unit TUNING HEAD receptacle J2, on the equipment rear panel, to POWER receptacle J1001, on the Tuning Unit rear panel.

(3) Connect display power cable W3 from the Power Unit DISPLAY receptacle J3, on the equipment rear panel, to POWER receptacle J301, on the Spectrum Display Unit rear panel.

(4) Connect the coaxial cable W5 from the Spectrum Display Unit TUNING HEAD jack J302 (type UG-291/U, on the equipment rear panel) to DISPLAY UNIT jack J1002 on the Model LTU-1 RF Tuning Unit rear panel.

2. TABLE OF CONTROLS.

The following table lists the various operating controls of the Model LTU-1 RF Tuning Unit. Locating and functioning information of each control and adjustment is included.

TABLE 1. OPERATING CONTROLS AND ADJUSTMENTS.

Control	Location	Function
TUNING	Front panel.	This control varies the tuning capacitors in the frequency-determining tank circuits of the two local oscillators.
IF ATTENUATOR	Front panel.	Provides 60 db of IF attenuation, in nominal 6 db steps.
RANGE SELECTOR	Front panel.	Selects either the 10-100 mc range in one position, or the two upper frequency bands of operation in the other position.
OSCILLATOR BIAS R1001	Top side of chassis, to the right and front of V1201 oscillator compartment.	Sets the bias potential applied to the control grid of the pencil-triode local oscillator in the 100-1000 mc range.
TUNING INDUCTORS L1101 thru L1111.	Top of preamplifier sub-chassis.	Preamplifier alignment.

3. STARTING PROCEDURE.

a. Be sure that all inter-unit cable connections are properly made. (Refer to par. 1 in this section, and to fig. 3.)

b. Turn the POWER switch, located in the lower left section of the Model LPU-1 Power Unit front panel, to its ON position, and allow a ten minute warm-up period.

c. Check the crystal current deflection on the Power Unit front panel when using the 100-1000 mc range. Look for the sweep trace on the screen of the Spectrum Display Unit, as directed in Part One, Instruction Manual for the basic units of the Model LSA Spectrum Analyzer.

d. Place the RANGE SELECTOR switch, on the Model LTU-1 RF Tuning Unit front panel, to the required position. For the 10 to 100 mc band this action energizes the dispersion limiting relay K301, located on the Spectrum Display Unit chassis, and limits the maximum frequency dispersion to 5 mc.

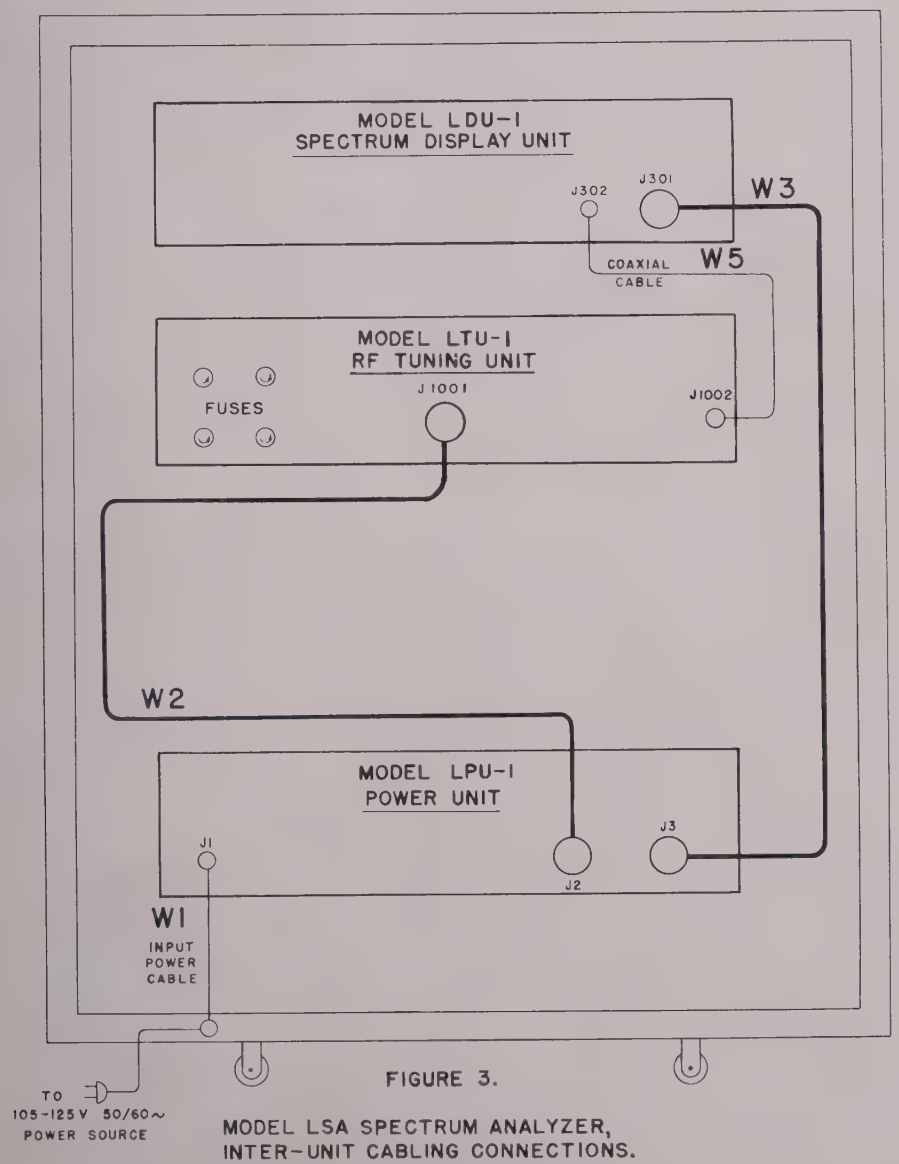

FIGURE 3.

MODEL LSA SPECTRUM ANALYZER, INTER-UNIT CABLING CONNECTIONS.

4. OPERATING PROCEDURE.

a. To apply an rf signal in the frequency range from 10 to 100 mc to the Tuning Unit, couple the signal from the source via a suitable pickup device to the 10-100 MC INPUT jack, and place the RANGE SELECTOR in its left-hand 10-100 mc position. The red-jeweled pilot, located to the left of the tuning dial, will light as an indication that only the low frequency local oscillator is in operation.

b. To apply an rf signal in the frequency ranges above 100 mc to the Tuning Unit, couple the signal from the source, via a suitable low-impedance pickup device, to the INPUT jack designated 100-1000 MC. (See note below). Place the RANGE SELECTOR in its right-hand 100-1000 position. The white-jeweled pilot, located to the right of the tuning dial, will light as an indication that the high-frequency local-oscillator is activated.

NOTE

A low-impedance coupling device must be used between the signal source and Tuning Unit INPUT jack for the 100-1000 mc range. The crystal mixer 0-1301, which is utilized in the 100-to-1000 mc bands of operation, requires a zero dc output impedance at the signal source. Use a loop type pick-up device, or an rf attenuator with low dc resistance in feeding signals to the Model LTU-1 RF Tuning Unit.

5. OPERATING PRECAUTIONS.

a. For proper operation of this equipment, it is essential that no image frequency pip, or spurious response pip, is mistaken for a true signal pip on the screen of the display unit. In operating over any frequency range of the Model LTU-1 RF Tuning Unit, apply an rf signal to the proper INPUT jack, and check to see that the RANGE SELECTOR is in the desired position. Observe the screen of the Spectrum Display Unit for the appearance of the pip representing the applied signal, and for possible appearance of spurious pips. If spurious pips are present, they may represent either the image frequency or an undesired spurious response. To eliminate the image frequency pip from consideration, rotate the tuning dial to higher frequencies. THE TRUE SIGNAL PIP WILL MOVE TO THE LEFT EDGE OF THE SCREEN, WHILE THE IMAGE PIP WILL MOVE TO THE RIGHT.

b. Spurious responses must be carefully distinguished from true signal pips, if proper information concerning the signal under test is to be obtained. Spurious responses inherent in the equipment, with instructions for eliminating them from consideration, are summarized in the following table 2.

TABLE 2. SPURIOUS SIGNALS.

	Band of Operation	Spurious Response Occurs at Following Frequency	Explanation	Eliminate spurious response from consideration as directed below
1	10-100 mc	10-12.5 mc	. . . .	Undesired pip moves 5 mc from right to left as tuning dial is rotated up-scale.
2	10-100 mc	15-18 mc	. . . .	Undesired pip moves from right to left as tuning dial is rotated up-scale.
3	10-100 mc	16 mc.	. . . .	Undesired pip moves from right to left as tuning dial is rotated up-scale, from 16 to 17 mc. (See paragraph 5c for method of eliminating pip.)
4	10-100 mc	24.5 mc	. . . .	Undesired pip moves from left to right as tuning dial is rotated up-scale, from 24.5 to 26 mc.
5	10-100 mc	25 mc	. . . .	Undesired pip moves from right edge of screen to center, and then drops out, as tuning dial is rotated up-scale, from 25 to 28 mc.
6	10-100 mc	30 mc	. . . . .	Undesired pip moves from right to left as tuning dial is rotated up-scale from 30 to 32 mc.
7	100-1000 mc (80-to-550 mc calibrated scale)	148-to 172 mc.	Signal frequency falls within the IF pass-band.	Undesired pip remains stationary on the screen when tuning dial is rotated. The true signal pip moves in accordance with rotation of the dial.
8	100-1000 mc (32--to-1260 mc calibrated scale)	456-to-504 mc	Spurious response is an image of the fundamental frequency of the local-oscillator. For example: With the dial set at 470 mc, the second har-	Use the 80-550 mc calibrated scale, which is designed to cover the frequency range in which the fundamental frequency of the oscillator is used.

TABLE 2. SPURIOUS SIGNALS (cont'd.)

Band of Operation	Spurious Response Occurs at Following Frequency	Explanation	Eliminate spurious response from consideration as directed below
		monic of the local-oscillator is 630 mc. This harmonic heterodynes with an applied rf signal of 470 mc to produce the required 160 mc intermediate frequency. However, some mixing of the fundamental frequency of the oscillator, at 315 mc, occurs with the applied 470 mc incoming signal to produce a beat signal of 155 mc, which is within the IF pass-band.	

c. If the Model LTU-1 RF Tuning Unit is used on the 10-100 mc range, and the spurious pip that occurs at 16 mc interferes with equipment operation, the special filter cable that is supplied with the equipment must be used. Replace the Model LDU-1 Display Unit Cable, that connects jack J702 on the sweeper chassis to jack J803 on the narrow band amplifier, with the special filter cable. The following adjustment procedure must be followed whenever this cable change is made:

(1) Tune the RF Tuning Unit Model LTU-1 to 16 mc and observe the resulting spurious pip. See section II, paragraph 4, of this manual for tuning procedure. Refer to table 2 of this manual for the procedure for locating the spurious response.

(2) Remove the plug from the hole on the filter box and use a non-metallic alignment tool to adjust the trimmer capacitor for minimum response of the spurious signal.

(3) Place the RANGE SELECTOR switch in its 100-1000 MC position and remove cable W5 from the TUNING HEAD jack, J302, on the Display Unit.

(4) Adjust the Display Unit for a 25 mc dispersion.

(5) Connect a signal generator to J302 of the Display Unit. The frequency range of the signal generator should be at least 148 to 172 mc.

(6) Vary the frequency output of the signal generator from 148 to 172 mc and adjust C738 in the Display Unit sweeper chassis, until the displayed pip has a constant amplitude over the 25 mc band.

(7) Remove the signal generator from the circuit and replace with the RF Tuning Unit Model LTU-1.

(8) Repeat steps 1 through 7 until a minimum response of the spurious pip is received and until the amplitude of the signal is constant for the 25 mc band.

(9) Replace the filter box plug.

(10) When additional sensitivity is desired, the filter line may be replaced by the original line. Whenever this change is made, however, readjustment of C738 on the sweeper chassis is necessary to obtain constant amplitude of the signal pip over the 25 mc band. Do not use the filter cable unless it is necessary. A 6 db reduction in gain results from the use of this cable.

d. The CRYSTAL CURRENT meter, located on the Model LDU-1 Spectrum Display Unit front panel, is used to indicate that the high frequency local-oscillator tube is functioning. Any meter deflection is a sign of oscillator output. Disregard specific numerical values, since the pointer deflection varies as the oscillator is tuned over the complete range of the receiver. As long as the meter pointer deflects to some on-scale indication, the equipment is functioning properly. Trouble-shooting is required only in the event that no CRYSTAL CURRENT meter indication is obtained throughout the tuning range. Failure of the crystal mixer, or of the local-oscillator, may be the cause of the operational failure. Test the crystal in a crystal checker to eliminate the diode as a source of trouble!

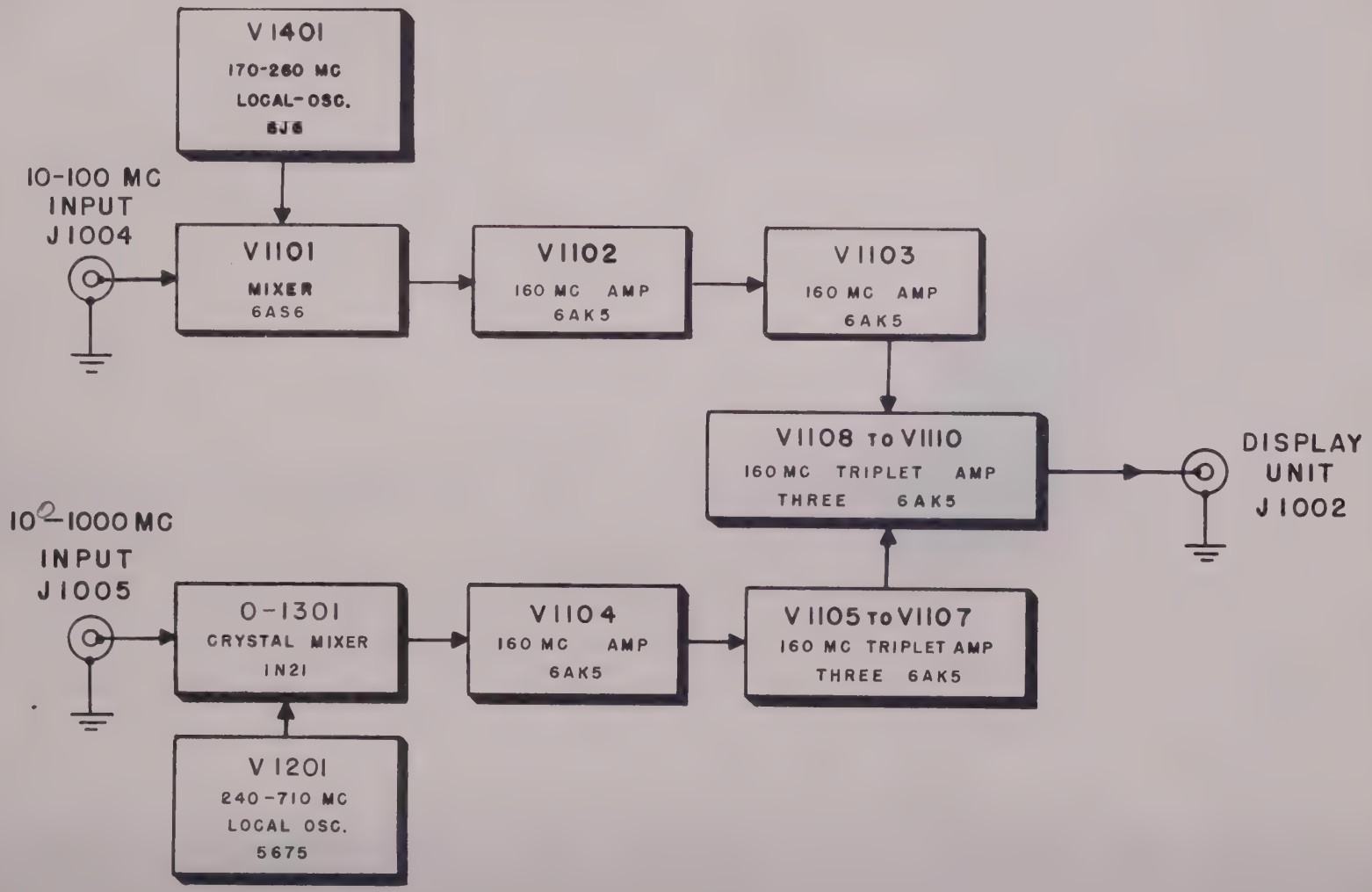

FIGURE 4. MODEL LTU-1 RF TUNING UNIT
FUNCTIONAL BLOCK DIAGRAM.

SECTION III

THEORY OF OPERATION

1. INTRODUCTION. (See figures 4 and 6.)

a. The Model LTU-1 RF Tuning Unit receives a radio-frequency signal in the range from 10 mc to 1000 mc. The tuning range is covered in three bands. The lowest band covers the spectrum from 10 to 100 mc, the middle band 80 to 550 mc, and the upper band 320 to 1260 mc.

2. DETAILED FUNCTIONING OF 10 TO 100 MC BAND. (See fig. 6.)

a. The local oscillator V1401 is a 6J6 tube, and uses a split-stator capacitor, C1401, and a center-tapped inductor, L1401, for the tank circuit. The frequency range of the oscillator is 170 to 260 mc. Plate potential is applied to this stage through resistor R1401 only when the RANGE SELECTOR switch is set to its left-hand 10 to 100 mc position. Heater power, obtained from the 6.3 volt output of transformer T1001, is applied through the filter impedance network, Z1402, and inductor L1403. The inductors L1403 and L1404 eliminate the effect of cathode-to-heater capacity. The entire local oscillator circuit is housed in a shielded compartment and is attached to the tuning unit chassis. The output of the local oscillator, tuned to 160 mc above the signal, is fed to a 6AS6 pentode, V1101, where it is mixed with the incoming signal. The difference frequency of 160 mc is selected by the tuned stages, V1102 and V1103, which follow the mixer stage. The amplified output signal is available at the UG-290/U jack J1104 at the rear of the preamplifier subchassis, and is coupled by coaxial cable W1003 to DISPLAY UNIT jack J1002 on the equipment rear panel. When coaxial cable W5 is connected between DISPLAY UNIT jack J1002 and TUNING HEAD jack J302 (which is loacted on the Spectrum Display Unit rear panel), conversion of the 160 mc amplified signal to lower intermediate frequencies occurs, after which action the detected video component is applied to the vertical deflection plates of the cathode-ray tube in the Spectrum Display Unit.

3. DETAILED FUNCTIONING, 80 TO 550 MC BAND. (See schematic circuit diagram.)

a. Local-oscillator V1201 consists of a pencil-triode type 5675 tube, connected in a butterfly-oscillator circuit. Its frequency-determining circuit, consisting of tuning assembly 0-1207, is connected in the plate-to-grid circuit of the tube, with C1202 functioning as a grid-leak capacitor to obtain self-bias voltage. The grid of tube V1201 is connected through inductor L1204, fixed resistor R1201, and the variable OSCILLATOR BIAS resistor R1001 to chassis-ground. The BIAS adjustment, which is made with a pick-up loop connected to the 100-1000 MC INPUT jack J1005, is made with the use of a vacuum-tube voltmeter, the negative probe of which is connected to the ungrounded side of the feed-through capacitor C1207. (See figure 5.) The positive probe of the vacuum-tube voltmeter is connected to chassis ground during this adjustment, and the potentiometer R1001 is set to produce a 1-volt pointer deflection on the voltmeter with the dial set at 80 mc. Heater power, derived from the 6.3 volt output of transformer T1001, is applied through filter impedance network Z1202 and inductor L1201 to one side of the tube's heater element. The other side of the heater is tied to the cathode of the tube. This junction is connected through the inductor L1202 to dc chassis ground. Plate potential is applied to the high-frequency oscillator tube V1201 through filter impedance network Z1201 and plate inductor L1205, only when RANGE SELECTOR switch S1002 is set to its right-hand 100-1000 mc position. Reference to figure 5, a top view of the chassis, shows that the entire oscillator circuit, including the tube, is housed within a shielded

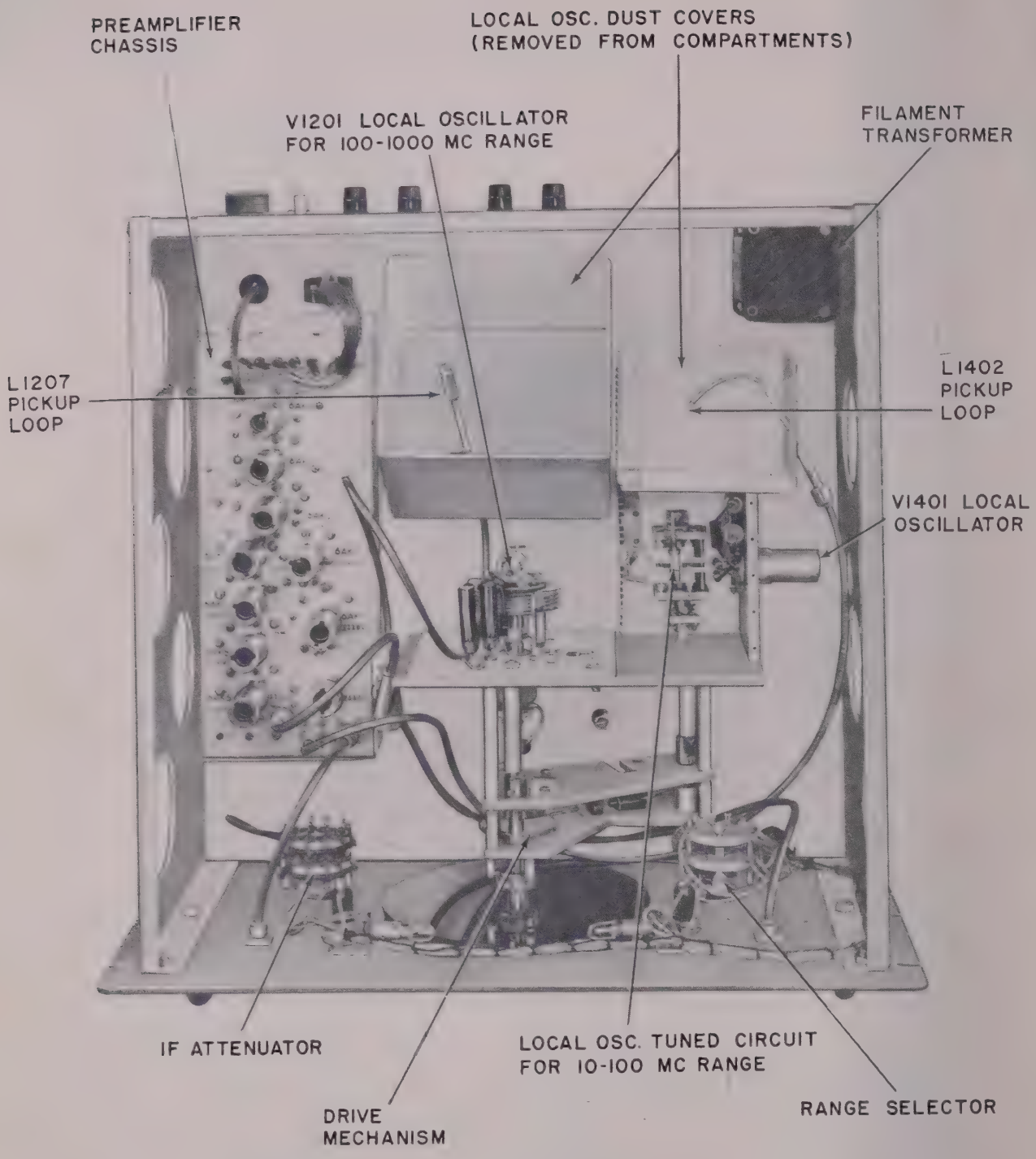

FIGURE 5. MODEL LTU-I RF TUNING UNIT, TOP VIEW.

compartment located directly to the right of the 160 mc preamplifier, as viewed from the front. The coupling between the drive mechanism and the tuning capacitor is accessible at the front (input) side of the shielded compartment. An L-shaped metallic plate, positioned by adjustment screws at the top of the shielded compartment, is located within the oscillator housing, and serves to eliminate parasitic oscillations over the tuning range. This plate is properly set during production tests, and field adjustment is normally not required.

b. The output of the oscillator is picked up by coupling loop L1207, and is fed through coaxial cable W1201 to the crystal mixer assembly O-1301. RF signals applied to the 100-1000 MC INPUT jack J1005, in the upper right corner of the equipment front panel, are also fed via a coaxial cable assembly (W1002) to the crystal mixer assembly. The oscillator voltage is fed to the input of the crystal diode CR1301, through the input resistors R1301 and R1302, while the applied rf signal voltage is fed through the 47-ohm impedance matching resistor R1303 to the diode input. In the operating range from 80 to 550 mc, the oscillator's fundamental frequency is always 160 mcs higher than the applied signal. Consequently, a beat signal of 160 mcs is present at the output of the crystal mixer. This beat signal is coupled through a short length of coaxial cable (W1301) to the UG-290/U input jack J1103, located at the front center of the amplifier sub-chassis.

c. The 160 mc beat frequency resulting from the difference between the oscillator-frequency and the applied signal-frequency is peaked by the 160 mc tuned inductor L1105, before the beat signal is fed to the input of a 6AK5 pentode tube V1104. Amplification of the signal is accomplished by coupling the output of tube V1104 into two cascade-connected stagger-tuned triplet amplifiers. The first triplet, which consists of the 160 mc tuned-amplifier V1105, the 175 mc tuned-amplifier V1106, and the 145 mc tuned-amplifier V1107, operates at a bandwidth of 30 mc. The second triplet, (also used for the 10-100 mc band) which receives the amplified signal through coupling capacitor C1135 and consists of tuned-amplifiers V1108, V1109, and V1110 (each of which is tuned to the same frequency as the corresponding stage in the first triplet), operates at a bandwidth of 30 mc. The overall bandwidth of the signal, which is available at the UG-290/U jack J1104 at the rear of the preamplifier sub-chassis, is reduced to 25 mc as a result of the cascading of the two triplets. This output signal is coupled by coaxial cable W1102, which runs along the under side of the tuning unit chassis, to DISPLAY UNIT receptacle J1102. The 160 mc amplified signal may then be connected to the Spectrum Display Unit for further conversion and amplification before the detected component is applied to the vertical-deflection plates of the display tube.

4. DETAILED FUNCTIONING, 320 TO 1260 MC BAND OF OPERATION. (See schematic circuit diagram.)

a. In operating the Tuning Unit over its highest range, from 320 to 1260 mcs, the second harmonic frequency of the pencil-triode oscillator tube is mixed with the incoming rf signal. This second harmonic component is actually developed in the crystal mixer CR1301, due to the mixer's non-linear characteristics. For example, when the Tuning Unit is tuned to a signal frequency of 320 mc, the fundamental local-oscillator frequency is 240 mc. The second harmonic of the oscillator frequency is then 480 mc. This second harmonic beats with an incoming 320 mc signal to produce a difference frequency of 160 mc, which is fed to the preamplifier.

b. The two stagger-tuned triplet preamplifier stages are fixed-tuned to amplify a beat signal of 160 mc. This beat signal is accepted by the preamplifier.

c. Heater transformer T1001 is mounted at the rear right corner of the Tuning Unit chassis. With 115-volt 50/60 cps power applied to its primary winding, the voltage across the secondary winding is stepped down to 6.3 volts. This stable ac voltage is applied to the heaters of all tubes in the tuning unit, to the two tuning dial illuminators E1001 and E1002, and to one of the panel pilots (either the red-jeweled E1003 when the RANGE SELECTOR is at its 10 - 100 mc position, or the white-jeweled E1004 when the RANGE SELECTOR is at its 100 - 1000 mc position.)

5. 10-100 MC FREQUENCY DISPERSION LIMITING CIRCUIT.

a. When RANGE SELECTOR S1002 is placed in its left-hand 10-100 mc position, one side of the primary winding of heater transformer T1001, at pin E of POWER receptacle J1001, is connected by inter-unit cables W2 and W3 to pin P of POWER receptacle J301, located on the Spectrum Display Unit chassis. Reference to figure 7, the schematic circuit diagram, in Part One Instruction Manual for the LSA equipment, shows that the lower terminal of the coil of dispersion limiting relay K301 is connected to pin P of the POWER receptacle, while the upper terminal of the coil is connected in shunt with the second side of the primary winding of heater transformer T1001. (See figure 8, schematic diagram for the Model LPU-1 Power Unit, in Part One Instruction Manual, for parallel connections between pins E and F of TUNING HEAD receptacle J2, and pins M and N, respectively, of DISPLAY receptacle J3). Therefore, whenever RANGE SELECTOR S1002 is at its 10-100 mc position, and inter-unit cables are properly connected, relay K301 has 115-volt ac power applied across its coil, and is in its energized position.

b. With relay K301 energized, the following circuit changes occur in the frequency dispersion stage V312:

(1) The 5 MC DISPERSION HIGH LIMIT control R384 is connected to the grid, pin 2, circuit of the V312 tube. This potentiometer controls the amplitude of the signal applied to the grid of the twin-triode type 12AU7 tube, and results in a maximum available frequency dispersion on the display tube of 5 mc. This dispersion corresponds with the pass band of the preamplifier tubes V1102 and V1103, which operate at a 5 mc bandwidth for the 10-100 mc band of operation of the Tuning Unit.

(2) The grounded contact terminal 6 of relay K301 is disconnected from terminal 5. This action connects the 5 MC DISPERSION LOW LIMIT control R383 in series with the FREQUENCY DISPERSION control R370 and fixed resistor R371 to ground.

c. Relay K301 is de-energized by placing the RANGE SELECTOR S1002 in its right-hand 100-1000 mc position. This action breaks the ac line to the coil of the relay, and a maximum frequency dispersion of 25 mc is then available for use in the 100-1000 mc band of operation. This frequency dispersion corresponds with the pass band of the two stagger-tuned triplets, which function as the pre-amplifier in the higher band of operation.

SECTION IV

MAINTENANCE

1. PRE-OPERATIONAL CHECKS AND ADJUSTMENTS.

a. The Instruction Manual, Part I, for the Model LSA Spectrum Analyzer gives complete pre-operational checks and adjustment procedures for the basic units. The following directions apply to Model LTU-1 RF Tuning Unit only, and are to be performed after all checks and adjustments to the basic units are completed.

(1) Examine all tubes to check that they are firmly seated in their tube sockets.

(2) Set the I-F ATTENUATOR to its 0 DB position.

(3) Examine all plugs and connectors to see that they are firmly seated and screwed tight to their receptacles.

(4) After connecting inter-unit cables (see figure 3), turn the POWER switch on the panel to its ON position. The tuning dial will be illuminated, and one of the panel pilots, either the red-jeweled 10-100 or the white-jeweled 100-1000 MC pilot, will light.

2. REPLACING THE PENCIL-TRIODE OSCILLATOR TUBE.

(Note. Check B plus and filament voltages before making any replacements.)

a. The type 5675 pencil-triode tube is used as the local-oscillator for two upper frequency bands. This tube is located within the shielded compartment to the right of the preamplifier, on the tuning unit chassis. If the CRYSTAL CURRENT meter shows no pointer deflection throughout the tuning range when the RANGE SELECTOR switch is in its 100-1000 mc position, first test the 1N21 crystal CR1301 in a crystal checker. After replacing with a crystal known to be in satisfactory operating condition, and reconnecting the appropriate coaxial cable, check the CRYSTAL CURRENT meter again for pointer deflection. If tube failure is indicated, replace the pencil-triode tube V1201.

(1) Place the POWER switch on the Power Unit to its OFF position.

(2) Remove the 4 No. 6-32 wingnuts which secure the housing. This action permits access to all components within the high-frequency local oscillator compartment.

(3) Remove the No. 2-56 screw which holds the clamp around the grid of the tube.

(4) Remove the "flea-type" contacts from the heater leads of the 5675 tube. If necessary, slide the tube slightly and gently along its supports, towards the bottom of the chassis, in order to remove the heater contacts.

(5) Carefully remove the tube by pulling straight out, gently, on both the cathode and anode with equal force.

b. Replacement of the pencil-triode tube with a new tube is performed as directed below:

(1) Carefully replace a new tube, known to be in satisfactory operating condition, and proceed in the reverse order to that listed above.

(2) Re-set the OSCILLATOR BIAS control R1001, a screwdriver adjustment located to the right and front of the oscillator compartment on the top side of the tuning unit chassis. Apply operating power to the tuning unit, and place the RANGE SELECTOR

in its 100-1000 mc position. Attach a pick-up loop to the 100-1000 MC INPUT jack, but do not apply a test signal to the TUNING UNIT. Place the negative probe of a vacuum-tube voltmeter on the ungrounded terminal of the feed-through capacitor C1207, and ground the positive voltmeter probe. Vary the screwdriver shaft of the OSCILLATOR BIAS control until a 1-volt meter indication is obtained. Check the setting of the BIAS control by observing the pointer deflection on the CRYSTAL CURRENT meter, located in the upper left section of the Display Unit front panel. Some pointer deflection on the CRYSTAL CURRENT meter will be observed as the TUNING dial is rotated throughout its range.

3. PREAMPLIFIER ALIGNMENT PROCEDURE.
(See schematic circuit diagram.)

a. Alignment of the preamplifier is performed by applying rf signals at specified frequencies to the appropriate INPUT jack, located on the preamplifier sub-chassis, and setting the tuning slugs located within the variable inductors to obtain maximum indications on an indicating device. Use a signal generator capable of producing a cw unmodulated signal over the frequency range from 145 mcs to 175 mcs as the signal source.

b. To align those preamplifier stages which function when the high-frequency band of operation is in use, place the RANGE SELECTOR switch S1002 to its right-hand 100-1000 MC position. Then proceed as directed below:

(1) Couple the output of the signal generator, which is set at 145 mc to INPUT jack J1103. This jack is located at the front center of the preamplifier, midway between tubes V1101 and V1104.

(2) Adjust the tuning slug within inductor L1108 (in the input circuit of tube V1107) and inductor L1111 (in the input circuit of tube V1110), for maximum output.

(3) Apply a 175 mc signal from the generator to the preamplifier jack J1103. Adjust the tuning slugs within inductor L1107 (in the input circuit of tube V1106) and inductor L1110 (in the input circuit of tube V1109) for maximum output.

(4) Apply a 160 mc signal from the generator to the preamplifier jack J1103. Adjust the tuning slugs within inductor L1105 (in the input circuit of tube V1104), inductor L1106 (in the input circuit of tube V1105), and L1109 (in the input circuit of tube V1108) for maximum output.

(5) Remove the output of the signal generator from jack J1103, and re-connect coaxial cable W1301 from the crystal mixer O-1301 to the input of the preamplifier. Couple the test signal from the signal generator, set to produce an output of 160 mcs, into the 100-1000 MC INPUT jack. Observe the screen of the Spectrum Display Unit for the positive pip representing this test signal. Rotate the IF ATTENUATOR control clockwise if the pip saturates the screen. Peak the setting of inductor L1105 by carefully trimming its position until maximum height of the signal on the screen is obtained.

c. To align the preamplifier stages which function when the low-frequency band of operation is used, place the RANGE SELECTOR in its left-hand 10-100 mc position, and proceed as directed below:

(1) Complete the steps outlined in subparagraph b., above.

(2) Couple the output of the signal source, producing output of 160 mc to jack J1102, located in the extreme right front corner of the preamplifier sub-chassis.

(3) Adjust the tuning slugs of inductors L1101 (in the output circuit of tube V1101), L1102 (in the input circuit of tube V1102), L1103 (in the output circuit of tube V1102), and L1104 (in the input circuit of tube V1103) for maximum output. Repeat several times to insure proper peaking.

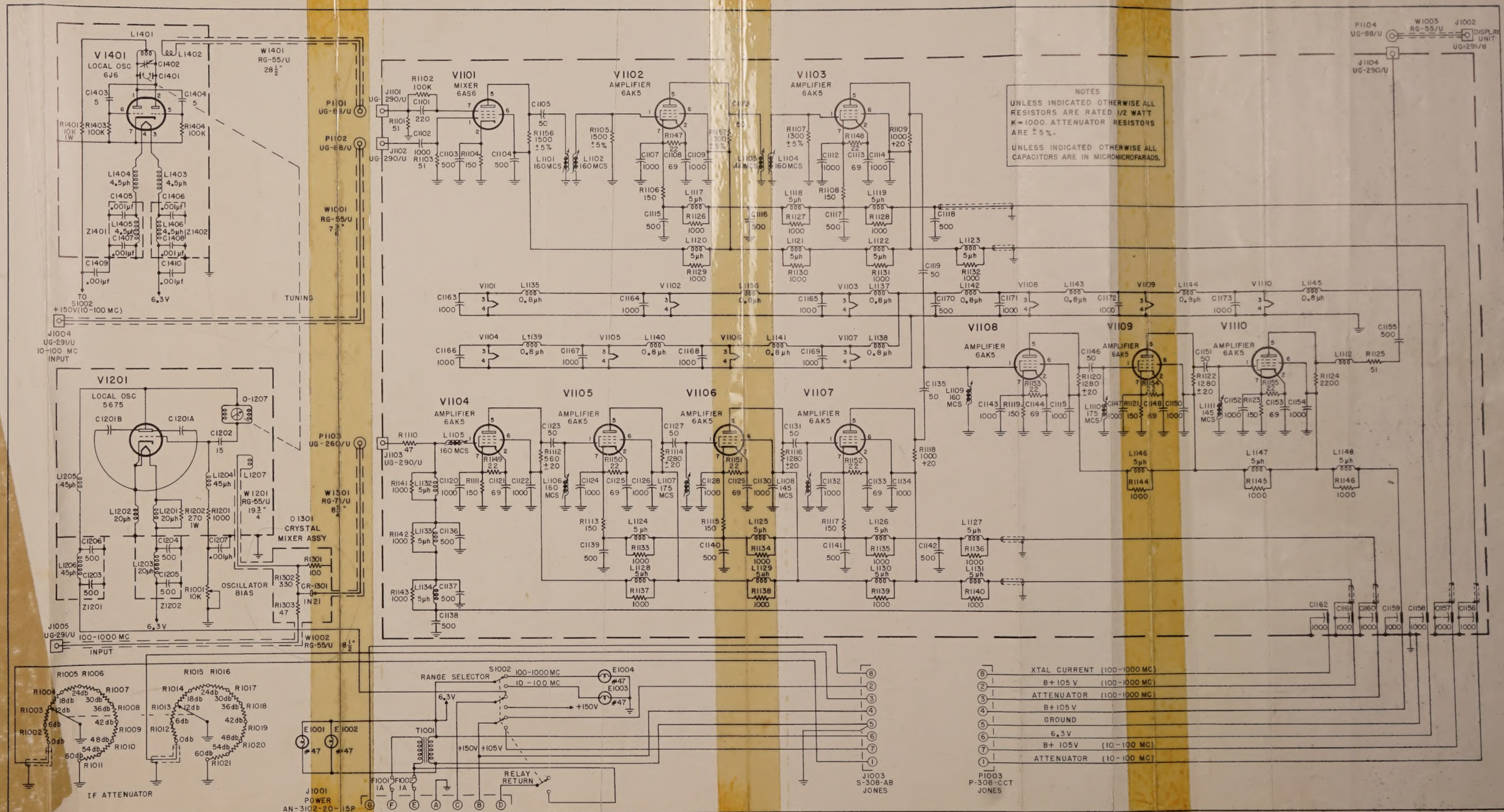

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FIGURE 6. RF TUNING UNIT (PART OF SPECTRUM ANALYZER) MODEL LTU-1
10-1000 MC, SCHEMATIC DIAGRAM.

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